Time series forecasting of COVID-19 cases in Brazil with GNN and mobility networks

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1 Correction

An error was identified in the LSTM model code. Upon reevaluation, it exhibited superior performance compared to the initially reported results. Subsequently, Table 3 from the prior paper, now referenced as Tab. 1, has been meticulously revised to accurately and comparatively depict the performance of the models.

All data and source code are available at the repository link: `https://github.com/hodfernando/BRACIS_GCN_2023`.

1.1 Comparing forecast models results

The Table 1 presents key metrics, including Mean, Maximum (Max), Minimum (Min), and Standard Deviation (Stand.), for RMSE values of COVID-19 forecast models applied in the Brazilian context.

Table 1: RMSE values of the forecast models of COVID-19 cases in Brazil.

Model	**RMSE (Cases)**			
	Mean	Max	Min	Stand.
GCRN	3059.50	**3699.74**	2108.77	500.39
GCLSTM	3583.88	4569.97	2847.56	**452.59**
LSTM	**396.71**	250275.07	**0.001**	4574.69
Prophet	480.74	51597.08	1.32	1703.10

In terms of Mean RMSE, the LSTM model stands out with the lowest value of 396.71, indicating superior overall performance in predicting COVID-19 cases

and also demonstrated an exceptional Min RMSE value of 0.001, signifying its capability to make highly accurate predictions in certain instances.

However, a closer look at the Max and Standard Deviation RMSE reveals a nuanced picture. The LSTM model exhibits the worst performances in these metrics. The Maximum RMSE, at 250275.07, underscores its vulnerability to substantial errors in specific predictions, while the Standard Deviation of 4574.69 suggests a wider variability in prediction accuracy.

This dual nature of the LSTM model, excelling in precise predictions but showing vulnerability to extreme errors and higher variability, highlights the need for careful consideration of model selection based on the specific forecasting requirements and tolerance for potential outliers. While LSTM's accuracy in mean and minimum RMSE is commendable, its limitations in handling extreme cases and maintaining consistency should be weighed against these strengths.

The robustness of prediction models is a critical aspect to consider, particularly reflected in the Standard Deviation of RMSE. GCLSTM emerges as the most robust model with the smallest standard deviation (452.59), indicating a consistent and reliable performance across various predictions. GCRN closely follows with a standard deviation of (500.39), also demonstrating a commendable level of robustness. Notably, GCRN achieves the lowest Max RMSE value of (3699.74), showcasing its ability to handle extreme cases more effectively.

Additionally, it's noteworthy that GCLSTM, with its robust performance, achieves a Minimum (Min) RMSE value of (2847.56), making it a reliable choice not only in maintaining consistency but also in providing accurate predictions even in less challenging scenarios. These findings underscore the importance of evaluating both mean and standard deviation metrics to assess a model's overall reliability and its ability to handle diverse prediction scenarios.

In summary, LSTM excels in Mean and Min RMSE, demonstrating precise predictions, while GCLSTM offers a more robust and consistent performance, as indicated by its lower Standard Deviation. GCRN shows competitiveness in both Max and Standard Deviation metrics, presenting a balanced performance. Interestingly, Prophet exhibits a performance akin to LSTM, showcasing similar behavior.

A noteworthy advantage of Prophet is observed in its superior performance compared to LSTM in terms of Max and Standard Deviation RMSE. Prophet manages to provide more stable predictions, especially evident in extreme cases, where LSTM shows limitations. This resilience positions Prophet as a valuable alternative, offering reliability and stability in COVID-19 case predictions. These nuanced variations in model performance metrics underscore the importance of considering specific forecasting needs, with LSTM excelling in precision, GCLSTM in stability, and Prophet providing a robust alternative, particularly in scenarios where extreme values may challenge other models.